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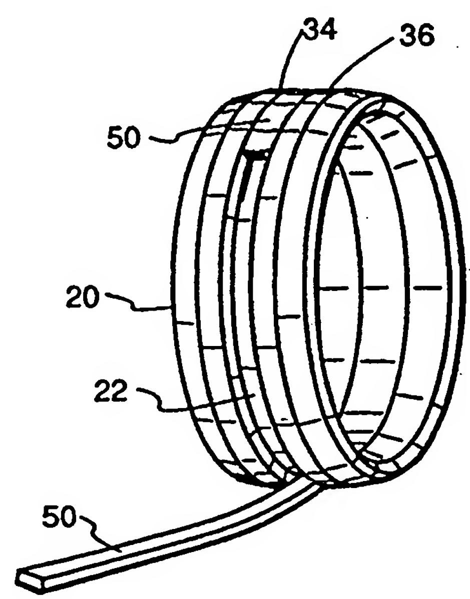
(54) Title: WEAR RESISTANT JEWELRY APPARATUS AND METHOD

(57) Abstract

Wear resistant jewelry apparatus and method of making same wherein articles of jewelry are made from sinterable metal and/or ceramic powder materials compressed into a predetermined configuration and then sintered to form a blank (20) from which a jewelry item may be made and to which softer precious metals (50), stones (110) or other materials suitable for use in jewelry may be affixed. Such items of jewelry may have multiple facets (34, 36) and can be fabricated using various disclosed techniques and various combinations of materials.



Specification

WEAR RESISTANT JEWELRY APPARATUS AND METHOD

Related Application

This application claims the benefit of the priority date of earlier filed U.S. Provisional Patent Application, Serial No. 60/60/058,136, filed September 8, 1997.

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates generally to jewelry items such as finger rings, bracelets, earrings, body jewelry and the like, and more particularly to novel jewelry apparatus and methods of making same out of "hard" metals and/or ceramic materials either alone or in combination with precious metals and jewels such that the hardened materials protect the softer precious metals and jewels from edge and detail weardown.

Background of the Invention

Jewelry has for centuries been made of soft materials such as gold, silver, platinum and other soft materials, because such metals were malleable, castable, forgeable, moldable or otherwise formable. However, whereas such materials are relatively easy to mold, shape and polish, they are equally subject to wear, scratching and other damage detracting from their longevity appearance and value, i.e., wearing down of edges to a smooth and rounded state.

More recently, science has produced other materials including tungsten, cemented carbide and high tech ceramics that are much harder than the previously mentioned precious metals, and once formed, are virtually indestructible when used in a normal jewelry wearing environment. The problem with such materials is that because of their hardness, they are very difficult to shape, and once formed, require special machining and/or grinding tools to alter their configuration and appearance. Accordingly, with the exception of articulated watch bands or housings for timepieces of the type made by Rado Watch Co. Ltd. of Switzerland, such materials have historically not been used for articles of jewelry of the types mentioned above. However, I

punches are usually made from an alloy of tungsten carbide or punched steel that can be hardened by oil quenching.

Heating of the cold-welded metal powder is called the "sintering" operation. The function of heat applied to the cold-welded powder is similar to the function of heat during a pressure-welding operation of steel in that it allows more freedom for the atoms and crystals; and it gives them an opportunity to recrystalize and remedy the cold deformation or distortion within the cold pressed part. The heating of any cold-worked or deformed metal will result in recrystalization and grain growth of the crystals or grains within the metal. This action is the same one that allows one to anneal any cold work-hardened metal and also allows one to pressure-weld metals. Therefore, a cold-welded powder will recrystalize upon heating, and upon further heating, the new crystals will grow, thus the crystal grains become larger and fewer.

The sintering temperatures employed for the welding together of cold-pressed powders vary with the compressive loads used, the type of powders, and the strength required of the finished part. Compacts of powders utilized in accordance with the present invention are typically sintered at temperatures ranging from about 1000° C to in-excess of 2000° C for approximately 30 minutes. When a mixture of different powders is to be sintered after pressing and the individual metal powders in the compact have markedly different melting points, the sintering temperatures used may be above the melting point of one of the component powders. The metal with a low melting point will thus become liquid; however, so long as the essential part or major metal powder is not molten, this practice may be employed. When the solid phase or powder is soluble in the liquid metal, a marked delusion of the solid metal through the liquid phase may occur which will develop a good union between the particles and result in a high density.

Most cold-pressed and metal ceramic powders shrink during the sintering operation. In general, factors influencing shrinkage include particle size, pressure used in cold-welding, sintering temperature and time employed during the centering operation. Powders that are hard to compress will cold-shrink less during sintering. It is possible to control the amount of shrinkage that occurs. By careful selection of the powder and determination of the correct pressure for cold-forming, it is possible to sinter so as to get minimal volume change. The amount of shrinkage or volume change should be determined so as to allow for this change in the design of the dies used in the process of fabricating a given shape.

The most common types of furnace employed for the sintering of pressed powders is the continuous type. This type of furnace usually contains three zones. The first zone warms the

Another advantage of the present invention is that articles of jewelry made in accordance therewith, maintain their luster for life and do not require frequent polishing.

Still another advantage of the present invention is that articles of jewelry made in accordance with the methods described are not subject to normal wear and thus, maintain their design details and value indefinitely.

Yet another advantage of the present invention is that numerous shapes and configurations of rings, earrings, bracelets and the like can be made using a variety of combinations of materials and colors of materials.

These and other objects and advantages of the present invention will no doubt become apparent to those skilled in the art after having read the following detailed description of the preferred embodiments illustrated in the several figures of the drawings.

IN THE DRAWING

Fig. 1 is a diagram schematically illustrating a press mold of a type used to make jewelry articles in accordance with the present invention;

Fig. 2 is a partially broken perspective view illustrating details of one form of a molded ring component in accordance with the present invention;

Fig. 3 is a perspective view illustrating one step in the preparation of a ring component in accordance with the present invention;

Fig. 4 is an illustration depicting a sintering step in accordance with the present invention;

Fig. 5 is a perspective view illustrating one method of combining a precious metal component with a hard metal and/or ceramic component in accordance with the present invention;

Fig. 6 is a flow chart illustrating steps followed to make jewelry in accordance with one embodiment of the present invention;

Figs. 7 -14 are partial cross-sections taken through various embodiments illustrating alternative forms of rings made in accordance with the present invention;

Fig 15 illustrates a unitary multifaceted hard metal/ceramic ring; and

Fig. 16 depicts a precious metal ring having a hard metal/ceramic band embedded therein to provide a protective outer wear surface.

shown in broken section at 24, the central-most portion 26 of the internal surface of the blank 20 is cylindrical with the outboard portions or facets 28 being angled relative thereto at angles typically in the range of from 1° to 30° relative to surface 26. The axial extremes of the cross-section of this embodiment are generally semicircular, as illustrated at 32, and the outer surface is configured to have cylindrical flats 34 and 36 on opposite sides of grove 22, and angled facets or flats 38 and 40 on the opposite sides thereof. As an alternative, the facets 38 and 40 may be configured to have multiple facet surfaces.

Once removed from the mold, the blank 20 is shaped by machinery filing, sanding, trimming or other appropriate techniques and may be burnished as illustrated in Fig. 3 to provide a smooth or textured surface, and made ready for sintering. Once prepared, the blank 20 is inserted into a sintering oven and the temperature raised as suggested by the arrows 42, to a suitable sintering temperature for a predetermined period of time during which the blank becomes hardened and shrinks to a size appreciably smaller than the size of the original green blank. However, as indicated above, the mold was sized taking into consideration the anticipated subsequent shrinkage and as a result, the ring stock after sintering, has a predetermined size. This, of course, implies that a different mold will be required for each ring size. As an alternative, it will be understood that the blank may be pressed to have a tubular configuration from which multiple rings may be severed and machined to appropriate individual sizes.

Following the sintering operation, the ring stock can be ground and finish polished, and when appropriate, have a selected precious metal and/or other material installed in the groove 22 as suggested by the laying in of the soft metal strip 50 depicted in Fig. 5 of the drawings. Once the metal strip 50 is suitably installed using methods well known to jewelers, the assembly can be finish polished and made ready for market. It will, of course, be appreciated that other forms of materials can be inlaid into the groove 22. For example, preformed metal, stone, ceramic, shell or other segments could be glued or otherwise affixed to the ring. Preferably, such items will be slightly recessed below the surfaces of the facets 34 and 36 so as to be protected thereby.

Turning now to Fig. 6, which is a flow diagram illustrating the various steps followed in a preferred method of making a ring in accordance with the present invention. It will be noted that once a suitable press and mold has been prepared, the first step in making a ring or other object is to mix a predetermined combination of powdered metal or ceramic constituents to develop a sinterable metallic or ceramic powder. Once properly measured and disposed within the mold cavity, the powder will be compressed by the mold to develop an oversized "green"

Turning now to Figs. 7 through 14, various cross-sectional configurations of rings are depicted illustrating combinations of flats, facets, materials, inserts and component relationships. More specifically, in Fig. 7, a sintered metal part 60 is shown having a wide annular groove 62 formed in its outer surface and filled with a softer precious metal or other material 64. The top surface of material 64 may be flush with the top edges 66 of the facets 68 or may be recessed there beneath to enhance the protective function of the hardened metal part 60. This ring might have an axial length of 2-14 mm, a wall thickness of 1 - 2.8 mm and have facets at angles of from about 2% to 40% relative to the cylindrical surface 69.

In Fig. 8, a similar ring design is depicted, but in this case, utilizing a ceramic material as the hard surfaced part 70 with the sculpted precious metal part 72 being mounted within a groove 74 formed in the outer perimeter of the hard part 70. Note the different surface effects that can be achieved by increasing the angular relationship of the various facets and by depressing or recessing the surface of the insert 72.

Figs. 8 - 10 depict two-groove embodiments of both sintered metal and ceramic substructures at 76 and 78 respectively, each having precious metal or other inserts 80 and 82 formed in the annular grooves thereof, with the exterior surfaces of the inserts of the rings being treated differently to achieve substantially different visual effects. Note, that in either case, the "hard part" protects the softer precious metal part. Note that in this embodiment, the internal surface 83 is shown aligned rather than faceted. Other embodiments may be treated likewise.

In Fig. 11, a three-groove embodiment is depicted at 84.

Figs. 12-14 illustrate alternative embodiments in accordance with the present invention, wherein the hard metal or ceramic components are formed by two or more parts that are affixed together. For example, in Fig. 12, complementary annular sintered or ceramic parts 86 and 88 are provided with shallow bores 90 at several points around facing surfaces of the components, and a plurality of annular components 92 made of at least two materials 92 are sandwiched together and bored at intervals matching the bores 90, such that pins 94 may be extended through the bores in the ring components 92 with the ends thereof being extended into the bores 90 of the hardened ring components 86 and 88 to lend mechanical stability to the assembly. The various components 92 would, of course, be epoxied or otherwise bonded together.

In Figs. 13 and 14, three-part ring assemblies are illustrated at 96 and 98 respectively, with each being comprised of a central band 100 and 102 respectively, sandwiched between and mechanically bonded to a pair of exterior rings 104 and 105 respectively. In the case of the ring assembly illustrated in Fig. 13, for example, the exterior components 104 might be of sintered

distributed around the parameter, with other objects of precious metal gem stones or the like secured into the various openings for cosmetic purposes. Gem stones set in precious metal may be secured into said openings for protection from scratching and daily wear.

Another configuration similar to that depicted in Fig. 11 might include several concentric rings of varying widths and thickness of precious metal or other material sandwiched between concentric rings of varying widths, thicknesses and profiles of hard metal. The components are assembled and bonded together with the softer precious metal surfaces being recessed below the adjacent surfaces of the hard metal, thereby causing all of the outer wear surfaces to be protected by the super hard metals surfaces.

Annular rings, earrings and bracelets may also be fashioned by combining variations of precious metal bands with the protective hard metal individual parts bonded onto and into slots or grooves or flat areas of the substrate precious metal bands. These hard metal parts will be positioned to give maximum protections to the precious metal parts.

Articles of jewelry may be created using symmetrical or asymmetrical grid-type patterns. Machined hard metal parts of varying shapes and sizes may be assembled and bonded onto or into a precious metal substrate designed where precious metal is recessed for maximum durability.

Articles of jewelry in accordance with the present invention may be made with various types of hard metals and precious metals where the hard metal is used for both esthetic and structural strength purposes. Hard metal rods of varying shapes and sizes may be used in conjunction with precious metals to create a unique jewelry design having a very high structural strength. Articles of jewelry may be made entirely of hard metal or a combination of hard metal and precious metal where the cosmetic surfaces of the hard metal are ground to have a faceted look. These facets are unique to hard metal configurations in that precious metal is too soft and facet edges formed in such soft metals would wear off readily with normal everyday use.

The present invention has been described above as being comprised of a molded hard metal or ceramic component configured to protect a precious metal or other component; however, it will be appreciated that the invention is equally applicable to a multifaceted, highly polished jewelry item made solely of the hard metal composition or ceramic composition.

Furthermore, the present invention relates to a method of making jewelry wherein a rough molded and sintered part is subsequently machined to produce multiple facets and surfaces that can be highly polished to provide an unusually shiny ring surface that is highly

CLAIMS

1. An item of jewelry made of material selected from the group consisting of sintered metals and ceramics and having at least one highly polished facet formed on an outer surface thereof.

2. An item of jewelry as recited in claim 1 configured as an annular band having at least one annular groove formed in the outermost surface thereof and includes an insert of precious metal disposed within said groove.

3. An item of jewelry as recited in claim 2 wherein the outer surface of said inset of precious metal is recessed below adjacent extremities of said annular band.

4. An item of jewelry as recited in claim 3 wherein at least one gemstone is set in said insert of precious metal, the outermost surface of said gemstone being recessed beneath said adjacent extremities of said annular band.

5. An item of jewelry as recited in claim 3 wherein at least one gemstone is set in said insert of precious metal.

6. An item of jewelry as recited in claim 2 wherein at least one gemstone is set in a cavity in said band.

7. An item of jewelry as recited in claim 1 configured as an annular band embedded in a concentric band of precious metal and having its outermost circumference protruding above the outermost circumference of said concentric band.

8. An item of jewelry as recited in claim 1 wherein said annular band is comprised of at least two components axially separated by and joined together by at least one annular band of precious metal.

17. A method as recited in claim 12 wherein said affixed material is affixed to said annular blank by a mechanical interlocking of parts.

18. A method as recited in claim 11 wherein said blank is severed to form a plurality of sub-blanks, each forming at least a component of said item of jewelry.

19. A method as recited in claim 11 and further comprising affixing a gemstone or piece of precious metal to said item of jewelry.

20. A method as recited in claim wherein said component has a plurality of facets formed in an outer surface thereof.

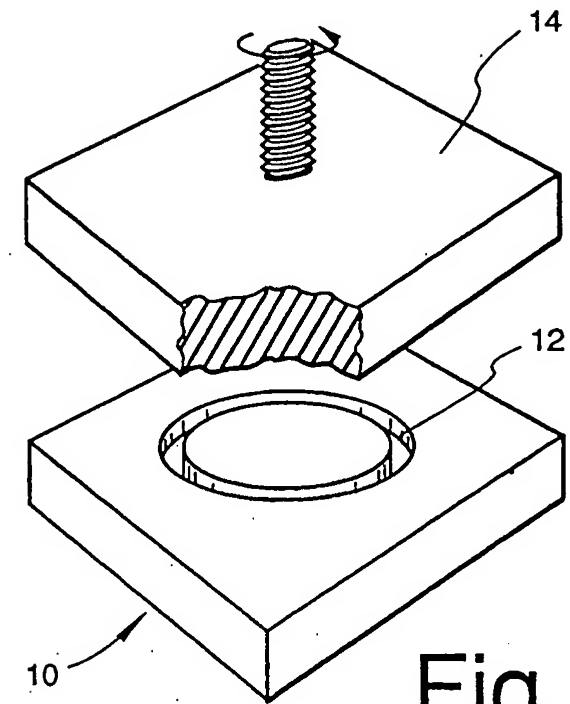


Fig. 1

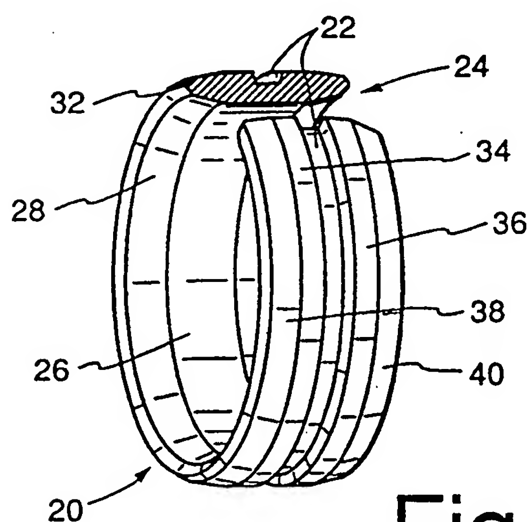


Fig. 2

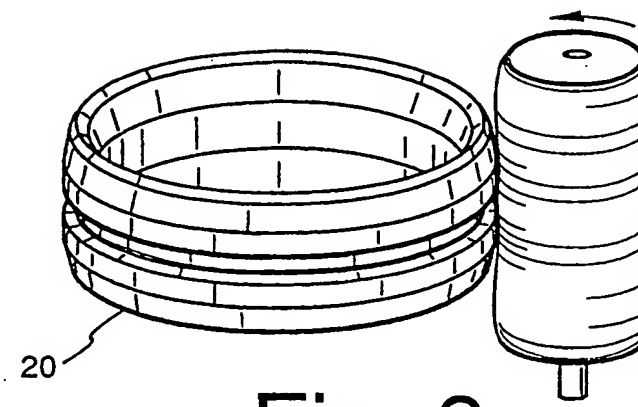


Fig. 3

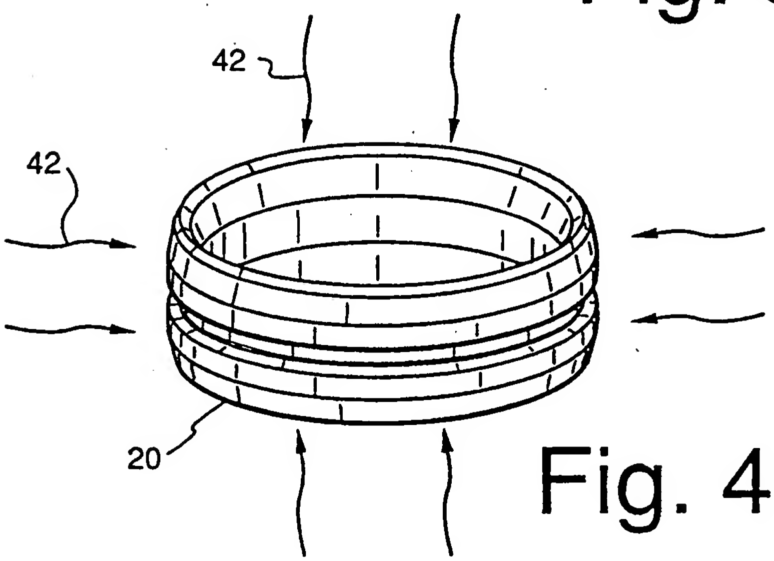


Fig. 4

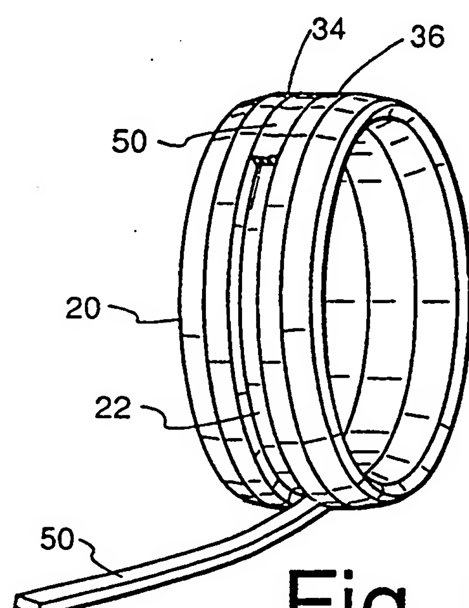


Fig. 5

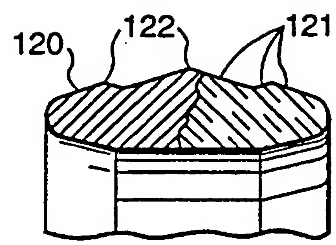


Fig. 15

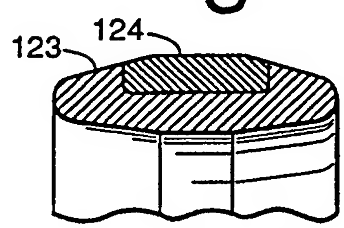


Fig. 16

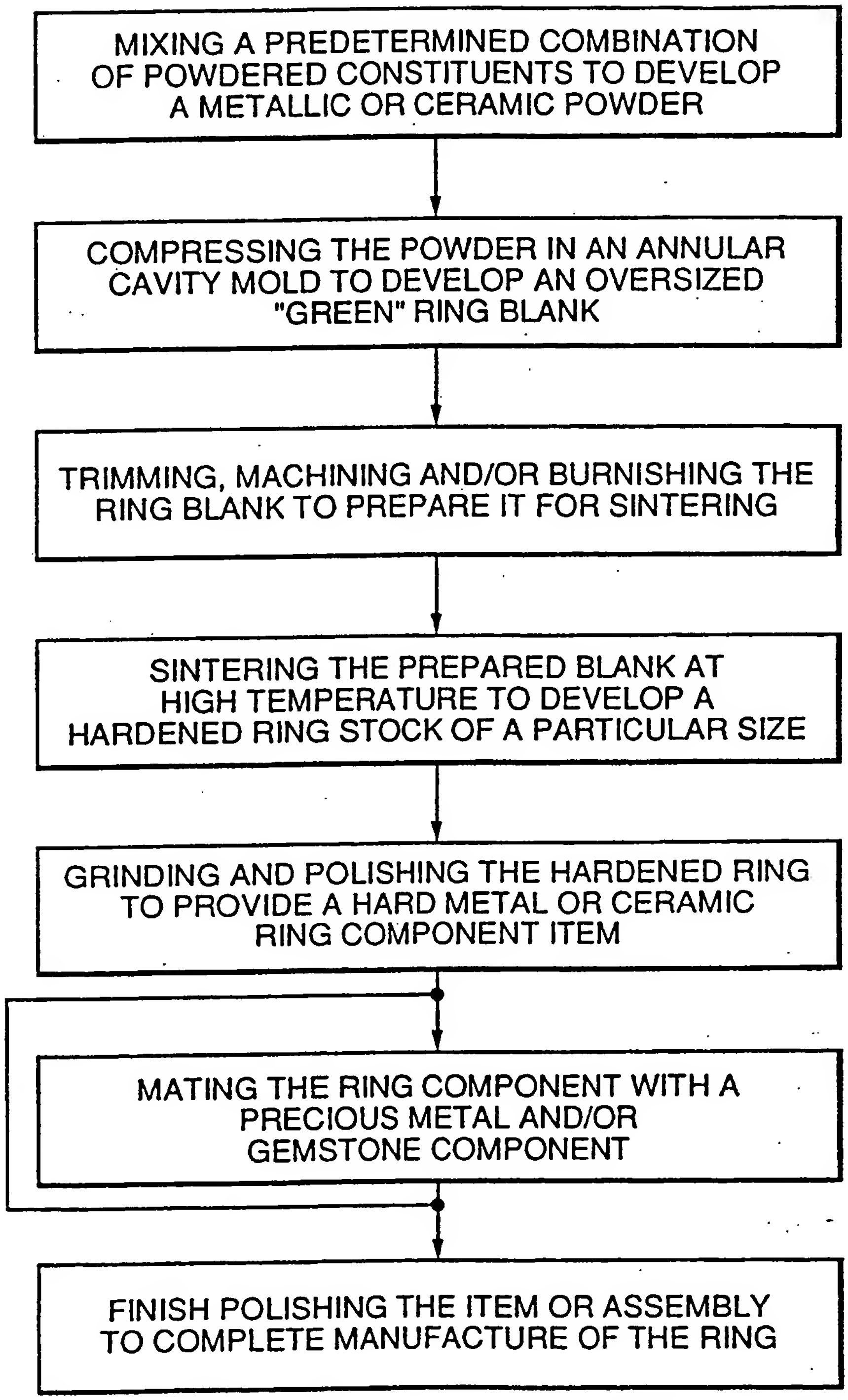

MIXING A PREDETERMINED COMBINATION OF POWDERED CONSTITUENTS TO DEVELOP A METALLIC OR CERAMIC POWDER
COMPRESSING THE POWDER IN AN ANNULAR CAVITY MOLD TO DEVELOP AN OVERSIZED "GREEN" RING BLANK
TRIMMING, MACHINING AND/OR BURNISHING THE RING BLANK TO PREPARE IT FOR SINTERING
SINTERING THE PREPARED BLANK AT HIGH TEMPERATURE TO DEVELOP A HARDENED RING STOCK OF A PARTICULAR SIZE
GRINDING AND POLISHING THE HARDENED RING TO PROVIDE A HARD METAL OR CERAMIC RING COMPONENT ITEM
MATING THE RING COMPONENT WITH A PRECIOUS METAL AND/OR GEMSTONE COMPONENT
FINISH POLISHING THE ITEM OR ASSEMBLY TO COMPLETE MANUFACTURE OF THE RING

Fig. 6

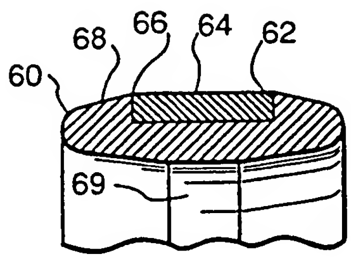


Fig. 7

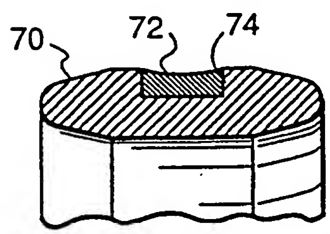


Fig. 8

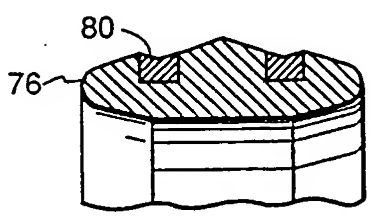


Fig. 9

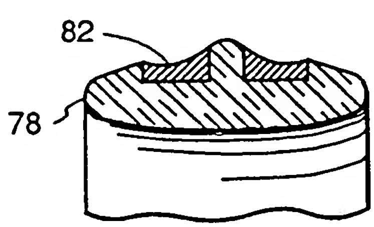


Fig. 10

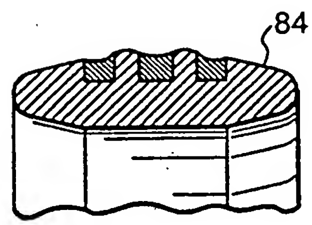


Fig. 11

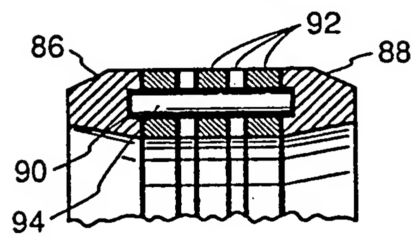


Fig. 12

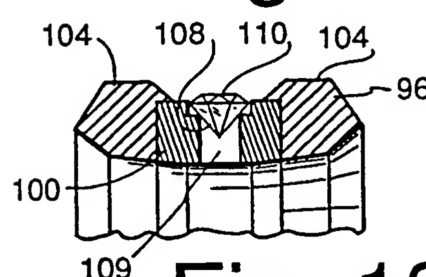


Fig. 13

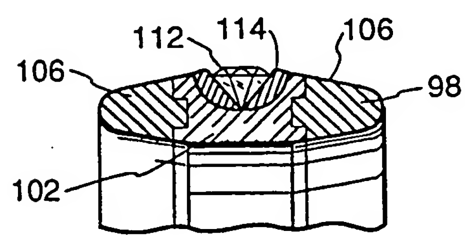


Fig. 14

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US98/18680

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :A44C 5/00; B22F 1/00
US CL :63/3; 419/26, 38
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 63/3, 15, 33, 34, 35; 419/26, 38

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

NONE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

APS
search terms: sinter? jewelry, 63/clas, ceramic or ceramics, sintered metal or sintered metals

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 3,669,695 A (ILER ET AL) 13 June 1972 (13/06/72), see entire document.	1 -------- 2-20
Y	AU 208883 A (PRESTON) 09 August 1956 (09/08/56), see entire document.	2, 3, 7, 12, 14-17, 19-20
Y	US 1,654,335 A (LINDROTH) 27 December 1927 (27/12/27), see entire document.	2-6
Y	US 2,016,679 A (MAYER) 08 October 1935 (08/10/35), see entire document.	8-9
Y	GB 2210249 A (BYRNE) 07 June 1989 (07/06/89), see entire document, especially Fig. 10.	10

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

* Special categories of cited documents:

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